ATTACHMENT 4
WASTE CHARACTERISTICS & ANALYSIS PLAN

This section describes chemical and physical characteristics of the chemical warfare materiel (CWM) items that will be treated by the Munitions Management Device, Version 1 (MMD-1) system. Also addressed is the Waste Analysis Plan (WAP) for the MMD-1 test, which describes the waste characterization requirements for the wastes to be treated, the treatment performance level goals for the treated wastes, and how proper disposition of the treatment residues and other process wastes will be determined. Information presented is based on process knowledge, material safety data sheets and/or chemical and physical analyses.

4.1 CHEMICAL AND PHYSICAL ANALYSES [40 CFR 264.13(a), 264.602; R315-8-2.4, R315-8-16]

The viability of the MMD-1 system to detoxify chemical agents or industrial chemicals will be tested using recovered non-explosively configured non-stockpile CWM items and Department of Transportation (DOT) cylinders containing: distilled mustard (HD), the nerve agents GB (isopropyl methylphosphonofluoridate) and VX (O-ethyl S-(2-diisopropylaminoethyl) methylphosphonothioate), and the industrial chemical phosgene (CG). **Table 4-1** identifies the chemical agents, industrial chemical phosgene, and associated munition type or DOT cylinder that will be processed during testing of the MMD-1 system and the maximum volume of agent each munition or DOT cylinder contains.

Appendix 4A provides chemical, physical, and toxicological data on the chemical agents (including decomposition products of the chemical agents due to age) and on the industrial chemical phosgene, that will be processed during the MMD-1 test. No unknown munitions will be used in the MMD-1 test. The munitions to be processed will have been identified (characterized) through the use of the Army-s Munitions Assessment Review Board (MARB). This review board determines the contents of munitions based on the best available information and for the MMD-1 test will identify the chemical agent contents of each of the munitions to be treated. The MARB summarizes its findings for recovered munitions in periodic reports.

Table 4-1. Chemical Agent and Industrial Chemical Amount and Chemical Warfare Test Items or DOT Cylinder

Phosgene - CG

Item No	Source	Container ID	Container Type	Quantity	Weight in Container, (lb)	Volume in Container, (gal)
1	DPG	GL 2689	Cylinder 155-mm equiv	1	8.21	0.69
2	DPG	GL 26_6	Cylinder 155-mm equiv	1	9.64	0.81
3	DPG	GL 2686	Cylinder 155-mm equiv	1	7.14	0.60
4	DPG	GL 2690	Cylinder 155-mm equiv	1	10.23	0.86
5	DPG	GL 2684	Cylinder 155 mm equiv	1	6.07	0.51
6	Comm	TBD	Cylinder 155-mm equiv	1	11.42	0.96
7	Comm	TBD	Cylinder 155-mm equiv	1	11.42	0.96
8	Comm	TBD	Cylinder 155-mm equiv	1	11.42	0.96
9	Comm	TBD	Cylinder 155-mm equiv	1	11.42	0.96
10	Comm	TBD	Cylinder 155-mm equiv	1	11.42	0.96
11	Comm	TBD	Cylinder 155-mm equiv	1	11.42	0.96
12	Comm	TBD	Cylinder M78 equiv	1	213.01	17.90
13	Comm	TBD	Cylinder M78 equiv	1	213.01	17.90
14	Comm	TBD	Cylinder M78 equiv	1	213.01	17.90
15	Comm	TBD	Cylinder M78 equiv	1	213.01	17.90
TOTAL				15 items	961.85 lbs	80.83 gals

Conversion Factor Used: Density (lb / gal) = 11.9
DPG = Dugway Proving Ground
Comm = Commercial Vendor
TBD = To be determined when the munition/DOT approved container is packaged for shipment to DPG.

Table 4-1 continued

Nerve Agent GB

ItemNo	Source	Container ID	Container Type	Quantity	Weight in Container, (lb)	Volume in Container(gal)
1	DPG	DPG-94-005	M139	1	0.66	0.072
2	DPG	RMA-95-001	155 mm	1	8.87	0.964
3	DCD	TBD	155 mm	1	8.87	0.964
4	DCD	TBD	155 mm	1	8.87	0.964
5	DCD	TBD	155 mm	1	8.87	0.964
6	DCD	TBD	155 mm	1	8.87	0.964
7	DCD	TBD	155 mm	1	8.87	0.964
8	DCD	TBD	155 mm	1	8.87	0.964
9	DCD	TBD	155 mm	1	8.87	0.964
10	DCD	TBD	155 mm	1	8.87	0.964
11	DPG	1	Cylinder 4.2-in equiv	1	5.02	0.55
12	DPG	16 *	Cylinder	1	0.93	0.10
13	DPG	17 *	Cylinder	1	0.93	0.10
14	DPG	31 *	Cylinder	1	0.29	0.03
15	DPG	5 *	Cylinder	1	2.19	0.24

Nerve Agent GB						
ItemNo	Source	Container ID	Container Type	Quantity	Weight in Container, (lb)	Volume in Container(gal)
16	DPG	6 *	Cylinder	1	2.19	0.24
17	DPG	82341C *	Cylinder	1	1.09	0.12
18	DPG	82346C *	Cylinder	1	0.72	0.08
19	DPG	82370C *	Cylinder	1	1.07	0.12
20	DPG	82375C *	Cylinder	1	1.22	0.13
21	DPG	82380C *	Cylinder	1	0.81	0.09
22	DPG	82397C *	Cylinder	1	1.17	0.13
23	DPG	82414C *	Cylinder	1	1.00	0.11
24	DPG	82419C *	Cylinder	1	1.01	0.11
25	DPG	82421C *	Cylinder	1	1.19	0.13
26	DPG	82423C *	Cylinder	1	1.15	0.13
27	DPG	82403C *	Cylinder	1	0.93	0.10
28	DPG	3 *	Cylinder	1	0.55	0.06
29	DPG	4 *	Cylinder	1	0.55	0.06
30	DPG	5 *	Cylinder	1	0.54	0.06
31	DPG	6 *	Cylinder	1	0.54	0.06
32	DPG	8 *	Cylinder	1	0.55	0.06
33	DPG	9 *	Cylinder	1	0.55	0.06
33	DPG	10 *	Cylinder	1	0.55	0.06
35	DPG	11 *	Cylinder	1	0.55	0.06
36	DPG	12 *	Cylinder	1	0.55	0.06
37	DPG	15 *	Cylinder	1	0.26	0.03
38	DPG	16 *	Cylinder	1	0.24	0.03
39	DPG	17 *	Cylinder	1	0.24	0.03
40	DPG	642774 *	Cylinder	1	2.11	0.23
41	DPG	953 *	Cylinder	1	0.95	0.10
42	DPG	954 *	Cylinder	1	0.73	0.08
43	DPG	898 *	Cylinder	1	1.70	0.18
44	DPG	997 *	Cylinder	1	1.14	0.12
45	DPG	DPG005 *	Cylinder	1	0.60	0.07
46	DPG	19 *	Cylinder	1	0.35	0.04
TOTAL				47 Items	117.21 lbs	12.74 gal

Conversion Factor Used: Density (lb / gal) = 9.2
DPG = Dugway Proving Ground
DCD = Deseret Chemical Depot
TBD = To be determined when the munition/DOT approved container is packaged for shipment to DPG.
* = Items to be processed as configured or repackaged into larger quantities.

Table 4-1 continued
Mustard (HD)

Item No	Source	Container ID	Container Type	Quantity	Weight in Container(lb)	Volume in Container(gal)
1	DPG	DPG-94-023	4.2 mortar	1	5.72	0.54
2	DCD	TBD	4.2 mortar	1	5.72	0.54
3	DCD	TBD	4.2 mortar	1	5.72	0.54
4	DCD	TBD	4.2 mortar	1	5.72	0.54
5	DCD	TBD	4.2 mortar	1	5.72	0.54
6	DCD	TBD	4.2 mortar	1	5.72	0.54
7	DCD	TBD	4.2 mortar	1	5.72	0.54
8	DCD	TBD	4.2 mortar	1	5.72	0.54
9	DCD	TBD	4.2 mortar	1	5.72	0.54
10	DCD	TBD	Cylinder M47equiv	1	73.25	6.91
11	DCD	TBD	Cylinder M47equiv	1	73.25	6.91
12	DCD	TBD	Cylinder M47equiv	1	73.25	6.91
13	DPG	DPG018	Cylinder	1	1.40	0.132
14	DPG	DPG019	Cylinder	1	3.40	0.321
15	DPG	DPG028	Cylinder	1	1.40	0.132
16	DPG	DPG039	Cylinder	1	1.40	0.132
17	DPG	Cylinder #1	Cylinder	1	0.90	0.085
TOTAL				17 items	279.73 lbs	26.39 gals

Conversion Factor Used: Density (lb / gal) = 10.6
DPG = Dugway Proving Ground
DCD = Deseret Chemical Depot
TBD = To be determined when the munition/DOT approved container is packaged for shipment to DPG.

Table 4-1 continued

Nerve Agent (VX)						
Item No	Source	Container ID	Container Type	Quantity	Weight in Container(lb)	Volume in Container (gal)
1	DPG	82342C	Cylinder 155-mm equiv	1	9.03	1.075
2	DPG	82364C	Cylinder 155-mm equiv	1	13.65	1.625
3	DPG	82372C	Cylinder 155-mm equiv	1	9.33	1.111
4	DPG	82373C	Cylinder 155-mm equiv	1	8.36	0.995
5	DPG	82374C	Cylinder 155-mm equiv	1	9.38	1.117
6	DPG	82384C	Cylinder 155-mm equiv	1	9.66	1.150
7	DPG	82385C	Cylinder 155-mm equiv	1	8.80	1.048
8	DPG	82388C	Cylinder 155-mm equiv	1	4.96	0.591
9	DPG	82398C	Cylinder 155-mm equiv	1	14.10	1.679
10	DPG	82434C	Cylinder 8-in equiv	1	15.00	1.786
11	DPG	82347C	Cylinder 8-in equiv	1	15.16	1.805
12	DPG	82366C	Cylinder 8-in equiv	1	14.20	1.691
13	DPG	82410C	Cylinder 8-in equiv	1	13.61	1.621
14	DPG	82420C	Cylinder 8-in equiv	1	15.05	1.792
15	DPG	14 *	Cylinder	1	0.72	0.090
16	DPG	10 *	Cylinder	1	0.92	0.110

Nerve Agent (VX)						
Item No	Source	Container ID	Container Type	Quantity	Weight in Container(lb)	Volume in Container (gal)
17	DPG	11 *	Cylinder	1	0.88	0.100
18	DPG	30 *	Cylinder	1	0.23	0.030
19	DPG	12 *	Cylinder	1	0.84	0.100
20	DPG	13 *	Cylinder	1	0.84	0.100
21	DPG	18 *	Cylinder	1	0.19	0.020
22	DPG	82352C *	Cylinder	1	14.54	1.730
23	DPG	82377C *	Cylinder	1	2.29	0.270
24	DPG	82382 *	Cylinder	1	14.13	1.680
25	DPG	82390C *	Cylinder	1	14.91	1.770
26	DPG	642770 *	Cylinder	1	1.60	0.190
27	DPG	642771 *	Cylinder	1	1.16	0.140
28	DPG	642751*	Cylinder	1	0.66	0.080
TOTAL				28 Items	214.20 lbs	25.50 gals

Conversion Factor Used: Density (lb / gal) = 8.4
DPG = Dugway Proving Ground
DOT = Department of Transportation
* Items to be processed as configured or repackaged into larger quantities.

Each MARB report summarizes the results of historical documentation, physical appearance, and nonintrusive characterization, which includes using portable isotopic neutron spectroscopy (PINS) and X-rays to determine whether a munition contains energetic material and to identify the type of chemical agent fill. The characterization results described in the MARB report for munitions at DPG were reviewed, and the chemical agents contained in the munitions were determined. CWM was then selected from this inventory for the MMD-1 test. Only non-explosively configured munitions (as determined by the MARB process) will be used in the MMD-1 test. The MMD-1 was designed for non-explosively configured CWM only. During MMD-1 test operations the fill contents of a munition will be confirmed by the Viking[7] gas chromatograph/mass spectrometer (GC/MS). If the Viking[7] GC/MS is inoperable, then Depot Area Air Monitoring System (DAAMS), or a sample bomb, or MINICAMS[7] will be used to collect and confirm the sample prior to preparing a treatment reagent solution.

The MMD-1 treatment process will generally consist of the following steps: 1) access (or breach) the primary container and confirm the chemical agent or industrial chemical fill, 2) select the proper reagent solution, 3) combine the reagent and chemical agent or industrial chemical (detoxification), 4) verify treatment performance, 5) transfer treatment residue, 6) decontaminate the CWM container metal parts, and 7) characterize and manage generated wastes according to the waste analysis plan.

The chemical agents or industrial chemicals will be detoxified in the munition treatment vessel (MTV) and/or the liquid reactor vessel (LRV), depending on the quantity of waste material to be treated. Waste gases will be treated in the gas processing and waste gas systems. All treatment systems will be located in the process trailer. Munition breaching, reagent transfer, and treatment operations will be conducted and monitored remotely by operators in the control trailer.
Each chemical agent and industrial chemical will be detoxified by specific reagents. The list of chemical agents and industrial chemicals to be treated and their associated reagents is presented in **Table 4-2.**

The favorable results of the Russian America Joint Evaluation Support studies over the last few years, provided a basis for development of the monoethanolamine (MEA) reagent mixture for the MMD-1. MMD-1 treatment reagents were evaluated and selected based on effectiveness at moderate temperatures, equipment compatibility, and safety. MEA with some water or sodium hydroxide (NaOH) added was found to meet these requirements for the treatment of HD, GB, and VX. Aqeous NaOH solution was selected to treat the industrial chemical phosgene.

MEA is used in the reagent mixtures for the treatment of HD, GB, and VX. MEA exhibits low toxicity, is not corrosive to stainless steel at the temperatures used, is inexpensive, is nearly nonflammable, and exhibits advantageous solvent properties. Laboratory studies have shown that by using water or NaOH additives, the MEA will rapidly react with HD, GB, and VX to form a homogeneous liquid product as described in Appendix 4B. MEA is an organic liquid that can dissolve many organic materials such as HD, VX, or their degradation products. Therefore, MEA is expected to be effective in rinsing agents out of munitions. Once used, MEA can be removed by water washing because it is miscible with water. Furthermore, since MEA can be used for all three chemical agents to be tested, its use simplifies purchasing, inventory, and chemical analysis requirements.

Table 4-2. Chemical Agents, Industrial Chemicals, and Associated Reagents

Chemical Agent/ Industrial Chemical[a]	Reagent
GB	monoethanolamine (MEA) and water
phosgene (CG)	Sodium hydroxide (NaOH) and water
HD	MEA and water
VX	MEA and NaOH

NOTE:a GB, HD, and VX are chemical agents; phosgene is an industrial chemical.

Table 4-3 describes the chemical agents and industrial chemicals to be detoxified in the MMD-1 and the resultant treatment residues (neutralent waste streams), the associated waste codes, and the basis for hazard designation including the applicable Resource Conservation and Recovery Act (RCRA) and State of Utah waste codes. RCRA waste codes may change based on analytical results obtained during MMD-1 test operations.

Detoxification will be considered complete and effective when chemical agent analytical results confirm treatment of the chemical agent to the desired performance level. The detoxification treatment goal is 1 mg/L (ppm) for each of the chemical agent reagent mixtures shown in **Table 4-2.** Each batch of chemical agent waste will be treated until the chemical agent concentration is less than 50 mg/L (ppm) in the decontamination solution.

The neutralent waste streams will be shipped offsite to an approved hazardous waste treatment, storage, and disposal facility (TSDF), only after the chemical agent waste is treated to less than 50 mg/L. **Table 4-4** presents the treatment performance goal levels for the liquid chemical agent treatment residues in milligrams per liter.

During MMD-1 operations treatment will be conducted in chemical agents and industrial chemical campaigns. During a campaign, only one CWM munition or DOT cylinder of a chemical agent or industrial chemical type will be in the MTV at a time. Procedural controls will ensure use of the correct reagent. Bench-scale laboratory tests have been conducted for the detoxification processes to determine chemical-agent/industrial-chemical-to-reagent ratios, initial reaction times, analytical methods, and method detection limits for chemical agents HD, GB, and VX, and to characterize the treatment residuals. This test chemistry information for the MMD-1 treatment process is provided in **Appendix 4B**. The amount of reagent used in a detoxification process is dependent on the volume of chemical agent to be detoxified. At a minimum, a ratio of 10:1 (by volume) of reagent to chemical agent or industrial chemical will be used. Processing strategies of the MMD-1 system are described in detail in Section 5 of this permit application.

Table 4-3. Industrial Chemicals, Chemical Agents, and Resultant Detoxification Residues

Description	Composition[a]	RCRA Waste Code[b]	Basis for Classification
Industrial Chemicals			
Phosgene	Corrosive gas: Acutely toxic	P095	Commercially supplied phosgene gas will be used in the MMD-1 test. The RCRA waste code has been applied at the request of DSHW.
Industrial Chemical Treatment Residues			
Phosgene and Neutralent [Phosgene (CG) and Sodium hydroxide and water]	Corrosive: Acutely toxic	D002, P095	Neutralent waste stream may meet the characteristic of corrosivity. Residues from tests involving phosgene will carry applicable listed and characteristic hazardous waste codes.
Chemical Agents			

Sulfur mustard HD; Nerve agents GB (Sarin) and VX	TC Metals[c], TC Organics, Acutely toxic	D004 to D011[c], D022[d], D028[d], D034[d], D039[d], D040[d], D043[d], P999[e]	Several TC organics have been identified as degradation compounds of mustard agents. These TC organics and regulatory levels are:
			$ chloroform (D022) - 6.0 ppm
			$ 1,2-dichloroethane (D028) - 0.5 ppm
			$ hexachloroethane (D034) - 3.0 ppm
			$ tetrachloroethylene (D039) - 0.7 ppm
			$ trichloroethylene (D040) - 0.5 ppm
			$ vinyl chloride (D043) - 0.2 ppm
			In addition, since munition bodies are constructed of specialty alloys containing heavy metals and over a period of time the chemical agent may have leached metals from munition casings, the Army conservatively designates chemical agents contained in munitions as TC metal wastes.

Table 4-3. Industrial Chemicals, Chemical Agents, and Resultant Detoxification Residues

Description	Composition[a]	RCRA Waste Code[b]	Basis for Classification
Chemical Agent Treatment Residues			
HD neutralent (HD and MEA and water)	See **Appendix 4B**.	D002, D004-D011[c], D022[d], D028[d], D034[d], D039[d], D040[d], D043[d], F999[f]	The neutralent waste stream may contain TC metals and organics. TC organics may be present as a result of degradation products from mustard agents. TC metals may be present as a result of leached metals from munition casings. The State of Utah lists the treatment residues from the destruction of chemical agents as F999. Based on test chemistry data, resultant neutralent wastes may meet the characteristic of corrosivity.
GB neutralent (GB and MEA and water)	See **Appendix 4B**.	D002, D004-D011[c], F999[f]	The neutralent waste stream may contain TC metals. TC metals may be present as a result of leached metals from munition casings. The State of Utah lists the treatment residues from the destruction of chemical agents as F999. Based on test chemistry data, resultant neutralent wastes may meet the characteristic of corrosivity.
VX neutralent (VX and MEA/NaOH)	See **Appendix 4B**.	D002, D004-D011[c], F999[f]	The neutralent waste stream may contain TC metals and organics. TC metals may be present as a result of leached metals from munition casings. The State of Utah lists the treatment residues from the destruction of chemical agents as F999. Based on test chemistry data, resultant neutralent wastes may meet the characteristic of corrosivity.
Decontaminated dunnage/ packing materials, solids	Shards of plastic, absorbent, metal shavings, dirt.	D004-D011[c], D022[d], D028[d], D034[d], D039[d], D040[d], D043[d], F999[f]	Decontaminated dunnage/packing material, metal shavings, dirt, and other debris may contain TC metals and organics. TC organics may be present as a result of degradation products from mustard agent. TC metals may be present as a result of leached metals from munition casings. The State of Utah lists the treatment residues from the destruction of chemical agents as F999.

Table 4-3. Industrial Chemicals, Chemical Agents, and Resultant Detoxification Residues

Description	Composition[a]	RCRA Waste Code[b]	Basis for Classification
Decontaminated munition body and parts; decontaminated DOT cylinders	Various alloys	***F999***	Metal casings, propellant charge cans, and other recyclable materials which fall into the category of scrap metal, although identified as solid waste, are considered recyclable materials under R315-2-6 [40 CFR 261.6(a)(3)(ii)] and will be managed as such. An F999 waste code will be applied per DSHW. These materials are expected to go to a smelter for recycling.
Decontaminated MMD-1 equipment parts, e.g., used saw blades and rinse waters	Various alloys	F999[f]	Decontaminated waste equipment parts and rinse waters may have been in contact with chemical agent and/or treatment residues during MMD-1 operations. The State of Utah lists treatment residues from the destruction of chemical agents as F999.

NOTES:

a Compositions of the chemical agents, industrial chemicals, and munitions are provided in **Appendix 4A** of this permit application.
b RCRA waste codes may change based on analytical results obtained during testing.
c Toxicity Characteristics (TC) metals have been assumed to be impurities in chemical agents contained in munitions. All waste codes listed may not apply.
d These constituents have been identified as impurities in or degradation products of mustard agents.
e The State of Utah lists chemical agents HD, GB, and VX as acutely toxic, applying State Waste Code P999.
f The State of Utah lists the residue from the treatment of chemical agents HD, GB, and VX as acutely toxic, applying State Waste Code F999.

EPA = Environmental Protection Agency
MEA = Monoethanolamine
NaOH = Sodium hydroxide

RCRA = Conservation and Recovery Act
TC = Toxicity Characteristics

Table 4-4. Chemical Agent Chemical Treatment Performance Level Goals for Liquid Wastes

Chemical Agent Treatment Residues	Level Goal Mg/Liter
HD and MEA/water	1
GB and MEA/water	1
VX and MEA/NaOH	1

Notes:
MEA = Monoethanolamine
mg/L = milligram per liter (parts per million)
NaOH = Sodium hydroxide

The MMD-1 process will generate liquid and solid waste streams. All agent-contaminated solids will be decontaminated and treated to the levels in **Table 4-5** as measured as a vapor concentration using headspace gas analysis. These levels are based on workplace time-weighted average concentrations. If porous, physically solid waste (i.e., materials inside a propellant charge container holding a patched munition or PPE or other materials that have contacted liquid chemical agent) is generated, the waste will be decontaminated and the decontamination fluid will be sampled for the presence of chemical agent. If chemical agent contaminated wood is generated and the wood is not sent off site in a container of appropriate decontamination solution, the wood will be decontaminated and then sampled, extracted and analyzed for chemical agent. Treatment of solids is accomplished by placing the solids in decontamination solution. All other waste characteristics, such as the TC organics D022, D028, D034, D039, D040, and D043) and TC metals (D004 through D011), may still apply to the treatment residues based on laboratory analysis.

Table 4-5. Chemical Agent Treatment Performance Level Vapor Goals for Solid Wastes

	Level[a] Goals	
Chemical	(mg/m^3)[b]	ppmv[c]
Mustard (HD)	0.003[d,e]	0.00045
GB	0.0001[d,e]	0.00002
VX	0.00001[d]	0.0000009

NOTES:

a Standards based on workplace exposure limits
b milligrams per cubic meter
c parts per million by volume at 20°C and 1 atmosphere
d Department of the Army (DA), Army Regulation (AR) 385-61, 1992
e Oak Ridge National Laboratory, 1992

4.2 WASTE ANALYSIS PLAN [40 CFR 264.13(b); R315-8-2.4]

This WAP addresses the wastes to be treated in the MMD-1 system and establishes the process by which the information needed to properly manage wastes at the MMD-1 system site will be obtained. Specifically, this WAP identifies what waste characterization information is needed, the nature and extent of the information needed, and the methods by which the information will be gathered.

During the MMD-1 test operations, this WAP will be kept onsite with the MMD-1 system operating record. A copy of the WAP will also be retained at the DPG Directorate of Environmental Programs. Upon completion of the test, this WAP and associated documents will become part of the MMD-1 operating record and will be kept at the Small Burials Contractor (SBC) facility through closure of the MMD-1 system and preparation and submittal of the final report and conclusions of the MMD-1 test.

This WAP will be revised and DSHW will be notified by telephone under the following conditions:

- When changes are made to test methods which affect the overall quality of the analyses as described in 60 FR 3091, January 13, 1995
- When waste streams or routine process operations are changed or modified, thus requiring a change in the parameters to be tested
- When regulations affecting the WAP are changed
- When the permit is modified or reissued.

All changes to the WAP made to facilitate the RD&D test program will be documented in the operating record.

4.2.1 Waste Analysis Plan Objectives

The primary purpose of waste sampling and analysis is to ensure that wastes are properly characterized in compliance with RCRA requirements for general waste analysis [40 CFR 264.13; R315-8-2.4]. The objectives of this WAP are to:

- Ensure safe handling, treatment, and disposition of all wastes
- Establish uniform waste characterization procedures
- Maintain operations within the MMD-1 system controls
- Ensure treatment residues (neutralent waste streams) and other process wastes are properly characterized for final disposition offsite at an approved hazardous waste TSDF.

4.2.2 Parameters and Rationale [40 CFR 264.13(b)(1); R315-8-2.4]

The DOT cylinders or reconfigured munitions containing chemical agents HD, GB, and VX that will be used in the test were prepared to well-defined Government standards and do not require additional characterization information for use in the MMD-1 test. MSDSs, Army documents such as Form 4508 transfer papers and other generator knowledge documentation will be maintained at the MMD-1 test area for each DOT cylinder or reconfigured munition containing chemical agent.

Recovered non-explosively configured munitions selected for use in the MMD-1 test have been adequately characterized by the MARB process to accept the items for treatment. The MARB process combines the results of several efforts in order to identify the contents of a munition. These efforts have included nonintrusive examination of the munition using portable isotopic neutron spectroscopy (PINS) and/or X-ray techniques to help determine what chemical agent is present, and the presence of energetic materials. The MARB also reviews historical documentation to assist in identification.

Similarly, the industrial chemical product phosgene (in gas cylinders) is well characterized by the manufacturer using MSDS and certificate of analysis. Therefore, no additional chemical analysis will be necessary to accept these materials for MMD-1 testing. During MMD-1 test operations, the fill content of a munition or DOT cylinder will be confirmed by the Viking[7] GC/MS. If unexpected problems arise and the Viking[7] GC/MS is inoperable, then DAAMS, then a sample bomb or MINICAMS[7] will be used to identify a munition fill, prior to selecting a treatment reagent solution. Unbreached range-recovered CWM items will not be placed into the MTV unless the Viking or other identification instruments are expected to be operational.

Table 4-6 identifies the parameters evaluated for performance monitoring of the MMD-1 during detoxification operations and rationale for selection. **Table 4-7** identifies the parameters evaluated for MMD-1 process wastes and the rationale for their selection.

4.2.3 Test Methods [40 CFR 264.13(b)(2); R315-8-2.4]

Table 4-8 lists the test methods that will be used for characterizing MMD-1 wastes. **Table 4-9** provides the test methods to be used for monitoring performance during detoxification operations. Analytical methods used for waste characterization are from: *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, current edition; *Annual Book of ASTM Standards*, American Society for Testing and Materials; *Methods for Chemical Analysis of Water and Wastes*, EPA (Environmental Protection Agency) 600/4-79-020, current revision; or other EPA-recognized methods. RCRA waste characterization analyses will be performed offsite at a Utah-certified laboratory for those parameters. Chemical-agent/industrial-chemical analysis will be performed by the onsite SBC laboratory.

After accessing or breaching the munition or DOT container within the MMD-1 MTV, a sample of chemical agent or industrial chemical vapor will be remotely collected. This vapor sample will be immediately analyzed by the Viking[7]GC/MS, MINICAMS[7], DAAMS or sample bomb methods to confirm the specific chemical agent or industrial chemical to be treated. The GC/MS will be located at the process trailer and remotely operated from the control trailer. This confirmation analysis will be used to select the proper treatment reagent. The proportions of the reagent to agent to be reacted has already been predetermined and is a minimum 10:1 volumetric ratio (reagent to agent).

Table 4-6. Parameters Evaluated for Performance Monitoring of MMD-1 and Rationale for Selection

Parameter	Rationale
Chemical agent concentration (at MTV, LRV, carbon adsorption unit, process trailer carbon filter, waste gas knockout drum, relief vent tank)	To monitor detoxification process when treating a chemical agent. To determine if treatment is proceeding appropriately.
Temperature	To determine if process systems are in off-normal operational conditions. Temperatures vary for individual subsystems.

NOTES:

CWM = chemical warfare materiel
MTV = munitions treatment vessel
LRV = liquid reactor vessel

The HD, GB, and VX neutralent waste streams (treatment residues) will be sampled and analyzed for chemical agents to verify that the chemical agent has been detoxified to the levels presented in **Tables 4-4** and **4-5**. Sampling and analysis will be conducted during and after the reaction. During treatment, both vapor and liquid samples will be collected and analyzed to monitor the progress of the reaction and to verify that detoxification has taken place. Upon completion of the treatment process, liquid and solid treatment residues will be sampled and analyzed for chemical agents or industrial chemicals (as applicable) and other parameters (see **Table 4-7**) as appropriate to characterize the treatment residues for final disposition offsite at an approved hazardous waste TSDF.

Other MMD-1 process wastes such as waste bead blast material will also be sampled and analyzed for residual chemical agents or industrial chemicals, as applicable, as well as other parameters to characterize the wastes for disposition offsite at a permitted hazardous waste TSDF.

Table 4-7. Summary of Selected Parameters for MMD-1 Process Wastes[a] and Rationale for Selection

Process Waste Description	Media Type		Parameters/Analyte	Rationale
HD, GB, and VX Neutralent Wastes (Treatment Residue)[b]	L, S	$	Chemical agent/Industrial chemical	1
		$	TC metals	3
		$	TC organics	3
		$	Metals analysis	3
		$	Organic analysis	3
		$	Physical state	4
		$	Corrosivity (pH)	5
		$	Reactivity (cyanides, sulfides, inorganic fluorides)	6
		$	Free liquids (solids only)	6
		$	Ignitability	6
		$	Btu	6
		$	Percent ash	6
		$	Specific gravity	6
		$	Solids content	6
			Oxidant - MEA- Method specified Condition II.C	
		$	Viscosity	6
Decontamination solutions, rinse waters, heat exchanger cooling waters, and canned pump reservoir fluids (ethylene glycol). (Heat exchange cooling waters and canned pump reservoir fluids to be generated at closure.)	L	$	Chemical agent/Industrial chemical	2
		$	TC metals	3
		$	TC organics	3
		$	Metal analysis	3
		$	Organics analysis	3
		$	Physical state	4
		$	Corrosivity (pH)	5
		$	Ignitability	6
		$	Reactivity (cyanides, sulfides, inorganic fluorides)	6
		$	Specific gravity	6
		$	Oil and grease	6
		$	Solids content	6
		$	Viscosity	6
Spent carbon from MMD-1 and unpack area carbon adsorption units and MMD-1 gas reactor	S	$	Chemical agent/industrial chemical	2
		$	Physical state	

Table 4-7. Summary of Selected Parameters for MMD-1 Process Wastes[a] and Rationale for Selection

Process Waste Description	Media Type		Parameters/Analyte	Rationale
Overpack material from CWM items to be treated (for example, rags, plaster, and other packing material)	S	$	Chemical agent/industrial chemical	2
		$	TC metals	3
		$	TC organics	3
		$	Metals analysis	3
		$	Organics analysis	3
		$	Physical state	4
		$	Ignitability	4, 6
		$	Reactivity (cyanides, sulfides, inorganic fluorides)	6
		$	Corrosivity (solids only)	6
		$	Btu	6
		$	Percent ash	6
Hydraulic fluids (to be generated at closure)	L	$	Chemical agent/industrial chemical	2
		$	TC metals	3
		$	TC organics	3
		$	Metals analysis	3
		$	Organics analysis	3
		$	Physical state	4
		$	Ignitability	4, 5
		$	Corrosivity	6
		$	Btu	6
		$	Specific gravity	6
		$	Percent ash	6
		$	Reactivity (cyanides, sulfides, inorganic fluorides)	6
		$	Viscosity	6
		$	Total halogens	6
CWM wastes remaining after treatment (plastic wrap, soil, other dunnage)	S		Chemical agent/industrial chemical	2
		$	TC metals	3
		$	TC organics	3
		$	Metals analysis	3
		$	Organics analysis	3
		$	Physical state	4
		$	Btu	6
		$	Percent ash	6
		$	Reactivity (cyanides, sulfides, inorganic fluorides)	6
		$	Ignitability	6
		$	Corrosivity	6
Bead blast material	S	$	Chemical agent/industrial chemical	2
		$	TC metals	3
		$	TC organics	3
		$	Metals analysis	3
		$	Organics analysis	3
		$	Physical state	4

Table 4-7. Summary of Selected Parameters for MMD-1 Process Wastes[a] and Rationale for Selection

Process Waste Description	Media Type	Parameters/Analyte	Rationale

NOTES:

a Process wastes include neutralent wastes (treatment residues), process waters, packing material, dunnage, personal protective equipment, and spent carbon from the carbon adsorption units.

b HD and MEA/water; GB and MEA/water; VX and MEA/NaOH; CG and NaOH.

CWM = chemical warfare materiel
DOT = Department of Transportation
L = Liquid
MEA = Monoethanolamine
NaOH = Sodium hydroxide
S = Solid
TC = Toxicity Characteristic
TSDF = Treatment Storage and Disposal Facility

Rationale:

1. Determine the concentration of chemical agent or industrial chemical as appropriate, to verify treatment effectiveness and for proper characterization for shipment offsite to a permitted hazardous waste treatment, storage, and disposal facility (TSDF).

2. Determine presence or absence of chemical agent or industrial chemical as applicable. Ensure safe handling, treatment, and disposition.

3. Ensure safe handling and proper characterization for shipment offsite to a permitted hazardous waste TSDF. Determine land disposal restrictions (LDRs) and treatment standards applicable to the waste including identification of underlying hazardous constituents.

4. Ensure proper handling and disposition.

5. Determine if waste is characteristically corrosive and ensure safe handling and disposition. Determine applicable treatment standards and LDRs.

6. Criteria may be required for offsite TSDF (for example, commercial incinerator) approval and acceptance purposes to ensure appropriate treatment and waste acceptability. Not all criteria listed for a particular process waste may be required, and the parameters and analysis performed will depend on the requirements of the TSDF that will receive the wastes for final treatment and disposal.

Table 4-8. Waste Characterization Methods[a]

Parameter/Analyte	Test Method[b]
Chemical agents in liquid treatment residues and rinse waters	U.S. Army Test Methods[c]
Chemical agents in waste decontamination solutions and rinse waters generated at closure	U.S. Army Test Methods[d]
Chemical agents in solids	Headspace gas analysis using near real-time (NRT) monitors and process knowledge for safety purposes
Industrial chemicals in solids	Process knowledge
Physical state	Process knowledge and/or visual inspection
Corrosivity (pH)	Method 9040A, 9045C (for solid sample matrices)
Reactivity (cyanides, sulfides, inorganic fluorides)	Method SW-846 Chapter 7.3.3.2, 7.3.4.2, and Method 9214
Oils and grease	Method 9070 or 9071A
Solids content (total suspended and total dissolved)	EPA 160.1[e] and 160.2[e]
Ignitability	Method 1010 or 1020
Btu (heat of combustion)	Method 5050
Percent ash	ASTM D482
Specific gravity	ASTM D1429-86, or D1217-86, or D5057
TC metals(arsenic, barium, cadmium, chromium, lead,mercury, selenium, silver)	Method 1311 (solids only) extraction followed by 6010A, 6020 or 7060A/7061, 7080A, 7130/7131A, 7190/7191, 7420/7421, 7470A/7471A, 7740/7741A, 7760, EPA 206.3[e], 208.1[e], 213.1[e], 218.1[e], 239.1[e], 270.3[e], 272.1[e]
TC organics(volatiles, semi-volatiles, pesticides, herbicides)	Process knowledge (Pesticides and Herbicides) and Method 1311 (solids only) and 8240/8260, 8260B, 8270C, 8081A, 8151A
Metals analysis(aluminum; antimony; arsenic; barium; beryllium; cadmium; chromium; cobalt; copper; iron; lead; manganese; mercury; molybdenum; nickel; thallium; tin; vanadium; zinc)	Method 6010B, 6020, or 7020; 7040/7041; 7060A/7061A; 7080A; 7090/7091; 7130/7131A; 7190/7191; 7200/7201; 7210/7211; 7380/7381; 7420/7421; 7460/7461; 7470A/7471A; 7480/7481; 7520; 7840/7841; 7870; 7910/7911; 7950/7951, EPA 202.1[e]; 204.1[e]; 206.3[e]; 208.1[e]; 210.1[e]; 213.1[e]; 218.1[e]; 219.1[e]; 220.1[e]; 236.1[e]; 239.1[e]; 243.1[e]; 245.2[e]; 246.1[e]; 249.1[e]; 270.2[e]; 272.1[e]

Table 4-8. Waste Characterization Methods[a]

Parameter/Analyte	Test Method[b]
Organics analysis(volatiles, semi-volatiles, pesticides, herbicides)Total halogens	Process knowledge (Pesticide and Herbicides Method 8260B, 8270C, 8081A, 8151A Process knowledge or Method 9020

NOTES:

a Samples will be analyzed by a Utah State-certified laboratory, or in the case of chemical agent analysis, by the SBC laboratory. For samples analyzed by a Utah-certified laboratory, methods used will have a current certification.
b Methods are from *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, SW-846, current edition, unless otherwise indicated.
c Analytical methods are those presented in U.S. Army Program Manager for Chemical Demilitarization Project Manager Non-Stockpile Chemical Materiel AHD/MEA Reactor Chemistry and Analytical Method Development for MMD-1,@ May 1997; AGB/MEA Reactor Chemistry and Analytical Method Development for MMD-1,@ July 1997; and AVX/NaOH/MEA Reactor Chemistry and Analytical Method Development for MMD-1,@ October 1997.
d Operation Numbers 1, 2, and 3 in TOCDF Laboratory Operating Procedure Number TE-LOP-572 for spent decontamination solution analysis, or DPG Chemical Test Division Method ***CL-002R***.
e *Methods for Chemical Analysis of Water and Wastes*, EPA 600/4-79-020, current revision.

ASTM = American Society for Testing and Materials
NRT = Near real-time monitors such as MINICAMS[7]
TC = Toxicity Characteristic
TCLP = Toxicity Characteristic Leaching Procedure

Table 4-9. Methods Used to Monitor Performance of MMD-1 Treatment Operations

Parameter	Method/Equipment
Temperature	Thermocouples (calibrated/certified)
Chemical agent (GB, VX, and HD)	Gas chromatograph/mass spectrometer (GC/MS), MINICAMS[7], DAAMS, or sample Bomb

Treatment effectiveness will be determined by collecting and analyzing vapor and liquid samples from the MTV, LRV, and/or surge tanks to monitor chemical agent and to verify completeness of the detoxification reaction to less than 50 mg/L for each chemical agent in the waste. Sampling and analysis will also be conducted to determine if the treatment performance goal of 1 mg/L has been met. Efforts taken to meet the treatment goal will be documented in the operating record. **Tables 4-4** and **4-5** present these treatment goals for chemical agents in liquid and solid treatment residues, respectively. Process monitoring samples and samples collected to confirm chemical agent concentrations in the neutralent waste stream below treatment levels or treatment performance goal levels will be analyzed onsite by the SBC laboratory.

4.2.4 Sampling Methods [40 CFR 264.13(b)(3); R315-8-2.4]

Table 4-10 lists the type of equipment and sampling methods, where appropriate, that will be used to obtain a representative sample of each waste stream. Also included in **Table 4-10** is the sampling method and equipment associated with MMD-1 performance monitoring that will be conducted during the detoxification process.

Methods used to obtain a representative sample will be consistent with the sampling approaches and protocols described in Chapter Nine of *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, current edition. For each waste stream sampled, one representative sample, plus appropriate quality assurance/quality control (QA/QC) samples, will be collected for each sampling event. **Appendix 4C** describes the waste sampling and analysis QA/QC protocols that will be followed during the MMD-1 test.

The appropriate sampling technique and container is selected based on knowledge of the waste material matrix (solid, liquid, gas) and the specific analytes of interest. Chemical agent or industrial chemical analysis samples will be analyzed onsite at the SBC laboratory. Samples for RCRA analysis will be shipped offsite to a Utah-certified analytical laboratory.

Table 4-10. Equipment and Sampling Methods for Waste Characterization and Process Monitoring

Media and Waste Stream	Sample Type	Method and Equipment	Frequency and Type of Sampling
Vapor			
Headspace in MMD-1 MTV	Grab	Viking[7], DAAMS, MINICAMS[7], Sample Bomb	Process: Each munition or DOT cylinder.
Vapor samples from MTV, LRV, gas reactor, waste gas knockout drum, and relief vent tank	Continuous and Grab	Collect grab samples at process trailer sample panel using gas sampling equipment, such as SUMMA[7] canister or equivalent, DAAMS tube, Tedlar J bag, or other equivalent sampling equipment. Collect continuous samples using MINICAMS[7] remotely.	Process: During processing of each munition or DOT cylinder.
Liquid (neutralent)			
MTV	Grab	Recirculate MTV content volume three times, then collect liquid sample from the discharge line of the re-circulation pumps servicing the MTV.	Process: During and at the end of each munition or DOT cylinder processing.
LRV	Grab	Recirculate LRV content volume three times, then collect liquid sample from the discharge line of the re-circulation pumps at the process trailer sample panel servicing the LRV.	Process: During and at the end of each munition or DOT cylinder processing.
Surge tanks	Grab	Recirculate surge tank content volume three times, then collect liquid sample from the discharge line of the re-circulation pumps servicing the surge tanks.	Waste: At the end of each processing batch. Each surge tank as generated.
Liquid (process wastes)			
Rinse water	Grab	Collect liquid sample from the discharge line of the re-circulation pumps servicing the MTV, LRV, or surge tanks.	Waste: Each time waste is generated for each munition and campaign during MMD-1 test and at closure of the MMD-1 system.
Cooling water	Grab	After draining and collecting water into stainless steel bulk containers, collect samples using simple random strategy (if multiphasic) using Coliwasa.	Waste: Once at closure of the MMD-1 system, each container generated.
Canned pump reservoir fluids/Barrier Fluids	Grab	After draining and collecting fluids into stainless steel bulk containers, collect samples using simple	Waste: Once at closure of the MMD-1 system, each container

Table 4-10. Equipment and Sampling Methods for Waste Characterization and Process Monitoring

Media and Waste Stream	Sample Type	Method and Equipment	Frequency and Type of Sampling
		random strategy (if multiphasic) using Coliwasa.	generated.
Solids			
Waste bead blast material	Grab	Collect samples from waste container using scoop, shovel, tongs, or trier.	Waste: Each container as generated.
Contaminated MMD-1 equipment parts (e.g., end mill or hole saw)	Grab	Remove in accordance with operations and maintenance (O&M) procedures. Sampling and analysis of headspace vapors using MINICAMS[7].	Waste: Each contaminated equipment part as identified.
Air monitoring of solids[b] $ Solids from MTV strainers $ Munition and DOT cylinder parts, propellent charge cans $ Waste bead blast material $ Plastic, soil, debris from CWM item remaining after treatment $ Spent carbon, and carbon filters $ Absorbed hydraulic fluid $ Personal Protective Clothing	Grab	Sampled solids or debris are containerized in DOT containers equipped with a sampling port or encased in plastic. The solids are allowed to vent into the container or plastic for 4 hours at a temperature equal to or greater than 70°F. A sample of the headspace vapors is collected using MINICAMS[7] or DAAMS. DAAMS samples are analyzed at the SBC laboratory.	Process and Safety: Each container generated.

NOTES:

a Process knowledge will be used to characterize this waste stream, therefore sampling and analysis will not be conducted.
b Air monitoring results will be used in determining proper handling and disposition of these wastes.

CWM = chemical warfare materiel
DOT = Department of Transportation
GC/MS = gas chromatography/mass spectrometer
LRV = liquid reactor vessel
MTV = munition treatment vessel
NA = Not Applicable

Minimum sample requirements for liquid samples and for solid and air samples, are provided in **Tables 4-11** and **4-12**, respectively. Sample container selection is critical to sample quality. Considering waste compatibility, durability, volume required for analysis, and analytical sensitivities, the containers listed in **Tables 4-11** and **4-12** are recommended for sampling efforts as applicable.

Basic sampling protocols to be followed are described below:

- $ Samples will be obtained using the equipment and methods described in **Table 4-10**. For RCRA analyses, sample containers will be supplied by the Utah-certified contract laboratory and will contain preservatives as appropriate for the analyte of interest. Samples will be collected using a precleaned or disposable sampler or using the sampling port or sampling lines located at the process trailer sampling panel MTV and surge tanks respectively.

- $ Sample containers may be filled in the following sequence, as applicable: chemical agent, then headspace volatile organics, volatile organics, semivolatile organics, metals, ignitability, pH (corrosivity), and reactivity parameters after chemical agent screening.

- $ Chemical agent samples will be analyzed before shipping samples for RCRA analysis. RCRA samples will not be released to the offsite laboratory unless chemical agent concentrations meet the guidelines stated in Section 3.4 Health and Safety Protocols of Appendix 4C of this permit application.

- $ Label all sample containers.

- $ Properly clean and decontaminate sample containers exterior and the sampling hardware (if necessary) and dispose of waste properly.

- $ Custody-seal sample containers, place containers in a leak-tight polyethylene bag, and place samples in a durable ice-filled cooler or comparable receptacle for transport to the laboratory. The sample containers may be wrapped in blister wrap or other protective material prior to placement in the cooler or comparable receptacle, if necessary.

- $ Complete the chain-of-custody and request-for-analysis forms. Retain a copy for project files.

- $ Review all paperwork and enclose the forms in a leak-tight, polyethylene bag taped to the underside of the cooler lid or other comparable receptacle.

- $ Seal the cooler or comparable receptacle and mark in accordance with DOT requirements as applicable.

- $ Transport samples to the onsite SBC analytical laboratory for chemical agent or industrial chemical analysis or ship offsite to a Utah-certified analytical laboratory for RCRA analysis.

Table 4-11. Minimum Sample Requirements for Liquid Samples

Analytical Parameter	Size	Container Type	Preservative	Holding Time[a]	Sample Volume
Chemical agent	125 mL	Amber glass, Teflon[J]-lined cap	4°C	30 days[b]	125 mL
Volatile organics	40 mL	Glass vial, Teflon[J]-lined cap	4°C, 4 drops HCl	14 days	3-40 mL
TC volatile organics	120 mL	Amber glass vial, Teflon[J]-lined cap	4°C	Extract within 14 days (solids <0.5%). Analyze extract within 14 days	120 mL minimal head space
Semivolatile organics	1 L	Amber glass jug, Teflon[J]-lined cap	4°C	Extract within 7 days. Analyze extract within 40 days	1 L per analysis
TC semivolatile organics	1 L	Amber glass jug, Teflon[J]-lined cap	4°C	Extract within 7 days. Analyze extract within 40 days	1 L per analysis
All metals/cations, except Cr^{+6}	1 L	P, G	HNO_3 to pH<2	180 days, 28 days for Hg in glass	1 L
Cr^{+6}	500 mL	P, G	4°C	24 hours	300 mL
TC metals	1 L	P, G	4°C	180 days, 28 days for Hg in glass	1 L
pH/corrosivity	125 mL	P	4°C	Analyze immediately	125 mL
Ignitability	500 mL	G	4°C	14 days	500 mL
Fluoride	125 mL	Polyethylene	4°C	28 days	125 mL
Sulfide, Reactive	250 mL	G	pH>9, NaOH/zinc acetate	7 days	250 mL
Cyanide, Reactive	250 mL	G	NaOH,pH > 9	7 days	250 mL
Suspended particulates	500 mL	P	4°C	7 days	500 mL
Oil and Grease	1L	G	4°C	28days	1 L

Table 4-11. Minimum Sample Requirements for Liquid Samples

Analytical Parameter	Size	Container Type	Preservative	Holding Time[a]	Sample Volume

NOTES:

a With the exception of chemical agent analysis, holding times are from the date of collection as referred to in Federal Register, Vol. 49, No. 209, October 26, 1984, as applicable.
b Holding time requested by Utah DSHW.

G = glass
L = liter
mL = milliliter
NA = Not Applicable
P = polyethylene
PCB = polychlorinated biphenyls
TBD = To Be Determined
TC = Toxicity Characteristic

References: U.S. Army (for chemical agent parameters), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, current edition.

Table 4-12. Minimum Sample Requirements for Solid Samples and Vapor Samples

Analytical Parameter	Size	Container Type	Preservative	Holding Time[a]	Sample Volume
Volatile organics	120 mL	Amber glass jar (WM), Teflon[J]-lined cap	4°C	14 days	100 g (minimum headspace)
TC volatile organics	500 mL	Amber glass jar (WM), Teflon[J]-lined cap	4°C	14 days to ZHE, 14 days from ZHE to analysis	200 g (minimum headspace)
TC semivolatile organics	1 L	Amber glass jar (WM), Teflon[J]-lined cap	4°C	Extract within 14 days to NVE, 7 days to extract the extract. Analyze extracts within 40 days	1 kg per analysis
Semivolatile organics	250 mL	Amber glass jar (WM), Teflon[J]-lined cap	4°C	Extract within 14 days to NVE, 7 days to extract the extract. Analyze extract within 40 days	200 g
All metals/cations, except Cr^{+6}	250 mL	Glass jar (WM)	4°C	180 days, 28 days for Hg	200 g
Cr^{+6}	250 mL	Amber glass jar (WM), Teflon[J]-lined cap	4°C	30 days to digest, 160 hours to analyze	30 g
TC metals	500 mL	Amber glass jar (WM), Teflon[J]-lined cap	4°C	Analyze extract within 180 days, 28 days for Hg	400 g
pH	100 mL	Glass (WM)	4°C	Analyze immediately	50 g
Free Liquids	250 mL	Glass (WM)	4°C	NA	100 g
Fluoride	250 mL	Glass (WM)	4°C	28 days	200 g
Cyanide, Reactive	200 mL	Glass	NA	NA	200 g
Sulfide, Reactive	250 mL	Glass (WM)	4°C	NA	200 g

Analytical Parameter	Size	Container Type	Preservative	Holding Time[a]	Sample Volume
Corrosivity/Ignitability	500 mL	Glass	4°C	NA	500 g
Chemical agent vapor	Variable	Sample Bomb Cylinder or equivalent	4°C	Analyze immediately	Variable

NOTES:

a With the exception of chemical agent analysis, holding times are from the date of collection as referred to in Federal Register, Vol. 49, No. 209, October 26, 1984, as applicable.

mL = milliliter
NA = Not Applicable
NVE = non-volatile extractables
PCB = Polychlorinated biphenyls
TC = Toxicity Characteristic
WM = Wide Mouth
ZHE = Zero Headspace Extraction

References: U.S. Army (for chemical agent and industrial chemical parameters), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, current edition.

As applicable, all sample containers will be labeled with at least the following information:

- $ A unique alphanumeric identifier
- $ Sample location
- $ Date and time of collection
- $ Sample collector's name
- $ Preservatives used
- $ Analyses requested.

Immediately after collection, filled sample containers will be placed on ice or Blue-ice[7], if necessary, in durable coolers or comparable receptacles for transport to the laboratory. If shipping samples offsite for analysis, coolers or comparable receptacles will be closed tightly, sealed with tape, and custody-sealed. Samples will then be transported to offsite laboratories via overnight courier to ensure delivery within 24 hours of sample collection. All sample collection, preparation, packaging, transportation, and analysis will conform to the requirements of SW-846, current edition, and the Program Manager for Non-Stockpile Chemical Materiel Laboratory Quality Control Plan and Procedures.

Sampling procedures are designed to ensure that each sample will be accounted for at all times. The primary objectives of the sample control procedures are as follows:

- $ Each sample collected for analysis will be uniquely identified
- $ Important and necessary sample constituents will be preserved (for example, refrigerated, capped)
- $ Samples are protected from loss, damage, or tampering
- $ Any alteration of samples during collection or shipping (for example, preservation, breakage) will be documented
- $ A record of sample custody and integrity will be established that will be legally defensible.
- $ The correct samples will be analyzed and will be traceable to the applicable data records (for example, chain-of-custody, field records, request for analysis, laboratory ledgers).

Sample collectors will maintain a permanent record of sampling activities. The record typically will include the following: purpose of sampling, date and time of collection, sample number, sampling location, sampling methodology, container description, waste description, description of process originating the waste, number and volume of samples, field observations, field measurements, destination and transporter, and signature of collector.

A chain-of-custody record will accompany samples at all times. MMD-1 test personnel collecting samples will be responsible for initiating and following chain-of-custody procedures and initiating sample custody records in the field at the time samples are collected. A chain-of-custody record form will document sample collection activities, including sampling site, sample identification, number of samples, and date and time of collection. Additionally, the form will document the chain-of-custody, including names of responsible individuals and dates and times of custody transfers.

Transportation of samples will be performed in accordance with DOT, EPA, and Army requirements. Hazardous waste samples will be properly packaged, marked, and labeled. Shipping papers will be prepared as required by DOT regulations, EPA requirements, and Army regulations and guidelines.

As applicable, equipment used to sample waste materials will be disposable or designed for easy decontamination. Contaminated disposable equipment will be managed as hazardous waste, as appropriate. Cleanable equipment will be thoroughly decontaminated prior to reuse. Spent decontamination solutions will be managed as hazardous waste.

4.2.5 Frequency of Analysis [40 CFR 264.13(b)(4); R315-8-2.4]

Waste streams will be re-evaluated any time an operation change such as a change in process, material, or equipment could result in a change to a waste stream. Annual analysis of waste streams will not be necessary because the MMD-1 test operations are expected to be completed within 6 months of startup. Sampling frequency for MMD-1 waste streams is provided in **Table 4-10**.

Sampling and analysis will be performed during treatment operations to determine if the detoxification process is proceeding appropriately. The parameters identified in **Table 4-6** will be monitored and samples will be collected at periodic intervals during the treatment process.

MMD-1 process effectiveness will be confirmed for each batch of neutralent wastes generated. The neutralent liquid wastes will be sampled at the surge tanks. The contents of the surge tanks will be thoroughly mixed prior to sampling. (See **Table 4-10**.) The sampling system constitutes a fluid loop in which material is passed through the loop over a period of time to purge the sample lines ensuring that the sample collected adequately represents the contents of a tank.

Neutralent waste streams will not be released from MMD-1 and Building 3445 engineering control for further waste analysis and disposition until chemical agent analysis has confirmed that treatment levels (50 mg/L) have been met. Once the treatment levels (50 mg/L) have been met, the neutralent wastes will be sampled at the surge tanks for chemical agent and RCRA analysis, then transferred from the surge tanks to bulk containers located in the Building 3445 West Chamber. The purpose of this sampling is to ensure that wastes generated from the treatment of different munitions during the same campaign and stored in the same surge tank meet treatment levels. This sampling will also show whether chemical agent is present in the surge tanks.

4.2.6 Additional Requirements for Ignitable, Reactive, or Incompatible Wastes [40 CFR 264.13(b)(6); R315-8-2.4]

As stated previously, the waste characterization information on the chemical agents and industrial chemical phosgene that will be processed during the MMD-1 test is well documented. No ignitable or reactive wastes will be used in the MMD-1 test. The chemical agents and industrial chemical that will be treated will be compatible with the treatment reagents, MMD-1 process equipment, and DOT waste containers because the MMD-1 was designed specifically to manage the chemical agents and industrial chemicals described in this permit application.

4.2.7 Sampling and Analysis Quality Assurance/Quality Control Procedures

Appendix 4C of this permit application presents the QA/QC requirements for sampling and analysis that will be followed during testing of the MMD-1 to ensure waste sampling and analysis objectives are met and that all data obtained are technically sound, statistically valid, and properly documented.

Chemical agent analyses will be performed by the onsite SBC laboratory. Samples for RCRA analysis will be shipped offsite to a Utah-certified laboratory.

4.3 WASTE ANALYSIS REQUIREMENTS PERTAINING TO LAND DISPOSAL RESTRICTIONS [40 CFR 264.13(c), 268.7; R315-8-2.4, R315-13-1]

The Hazardous and Solid Waste Amendments prohibit the land disposal of certain types of wastes that are subject to RCRA, and establish concentration limits and treatment standards for certain restricted wastes prior to land disposal. All MMD-1 wastes will be managed in accordance with land disposal restriction (LDR) requirements. Information presented in this section describes how the wastes that are subject to LDRs will be documented and certified.

Detoxification will be accomplished by altering the chemical properties of the chemical agents or industrial chemicals by the reaction with appropriate reagents. The neutralent waste streams and other process wastes may need to be treated further to achieve the treatment standards for corrosivity (D002), the toxicity characteristic (TC) metals (D004 through D011), TC organics (D028 and D043), and any identified underlying hazardous constituents associated with the chemical agents and industrial chemicals prior to land disposal. These waste streams will be sent offsite for this treatment at an approved hazardous waste TSDF in order to achieve LDR requirements prior to land disposal. The MMD-1 processes will be limited to detoxification only.

The SBC will provide written notification and/or certification as applicable with each shipment of waste to the receiving TSDF according to the requirements of 40 CFR 268.7.

Copies of all notices, certifications, demonstrations, and other documentation produced to support the determination for restricted wastes treated onsite, or treated, stored, or disposed of offsite at an approved hazardous waste TSDF will be retained in the MMD-1 operating files by the SBC for a period of at least 3 years.

4.3.1 Waste Characterization

The waste characterization requirements that will be followed for the wastes subject to LDRs are the same as described in Section 4.2 of this permit application. The information provided by this characterization will allow for determinations of LDR applicability and compliance with LDR treatment standards, concentration limits, and/or notification and certification requirements.

Storage of MMD-1 restricted wastes will be in accordance with the prohibitions of storage of restricted wastes, 40 CFR 268.50 and R315-13-1.

4.3.2 Sampling and Analytical Procedures

The sampling and analytical (test) methods that will be followed for wastes subject to LDRs are the same as described in Sections 4.2.3 and 4.2.4 of this permit application.

4.3.3 Frequency of Analysis

The frequency of analysis requirements that will be followed for wastes subject to LDRs are the same as described in Section 4.2.5 of this permit application.

4.4 ADDITIONAL REQUIREMENTS FOR TREATMENT FACILITIES

The following paragraphs describe the additional sampling, analysis, and documentation requirements for wastes treated in the MMD-1 system. Once waste has undergone treatment, the treatment residuals will be containerized, labeled, and stored in less than 90 day storage areas pending shipment offsite to a permitted TSDF. The residuals will be characterized as described in Section 4.4.1, and all required LDR notifications and certifications will be prepared by SBC personnel and forwarded with the waste shipment to the offsite TSDF.

4.4.1 Analysis of Treatment Residues

Analyses of treatment residues from restricted wastes will be performed to determine treatment effectiveness (to verify detoxification of chemical agents to established levels) and to characterize the residual wastes for LDR requirements. Characterization of treatment residuals is described in Sections 4.2.2 and 4.2.3.

4.4.2 Sampling and Analytical Procedures

Each batch of neutralent waste stream generated will be sampled and analyzed for chemical agents to determine treatment effectiveness. Sampling and analysis will be conducted on the treatment residuals as described in Sections 4.2.3 and 4.2.4 of this permit application.

4.4.3 Frequency of Analysis

The frequency of characterizing treatment residuals is presented in **Table 4-10**.